I. Amendments to the Claims

This listing of claims replaces without prejudice all prior versions and listings of claims in the application:

Listing of Claims:

1. (Previously presented) A reciprocating screw injection unit having a cyclic operating period, comprising:

an axially translating screw mounted within a barrel, the screw having associated therewith a non-return valve downstream of which a volume of melt can, in use, be accumulated;

a first actuator arranged to effect axial movement of the screw relative to the barrel and to generate, in use, back-pressure;

a second actuator coupled to the screw to control, in use, rotational speed of the screw; and

a controller for controlling operation of the screw and the first actuator, the controller arranged to set an axial position for the screw that defines the volume of melt to be accumulated downstream of the non-return valve by effecting, in use, an increase in the back-pressure to prohibit any further increase in the volume for melt accumulation and to render a recovery rate for the screw as being substantially zero and wherein the controller is arranged to ensure that the rotational speed of the screw, in use, is always above zero revolutions per minute.

2. (Original) The reciprocating screw injection unit according to claim 1, wherein the controller causes, during each injection cycle, selective variation of at least

one of:

a) the back-pressure; and

b) the rotational speed of the screw;

thereby to control axial translation of the screw and selectively and dynamically to vary the recovery rate of the injection unit during the injection cycle.

3. (Original) The reciprocating screw injection unit according to claim 1, further including a pressure transducer coupled to the controller.

4. (Original) The reciprocating screw injection unit according to claim 1, further including a screw position transducer coupled to the controller and responsive to the screw, the screw position transducer relaying screw position information to the controller for the purposes of at least one of:

back-pressure control; and

recovery rate control.

5. (Original) The reciprocating screw injection unit according to claim 1, further including a screw speed sensor coupled to the controller and the second actuator, the screw speed sensor relaying screw speed information to the controller for the purposes of dynamic recovery rate control during each injection cycle.

6. (Original) The reciprocating screw injection unit according to claim 1, wherein the screw has a tip located downstream of and proximate to the non-return valve and the barrel further has a chamber in front of the tip and into which chamber melt accumulates, the chamber having a final volume defined as a sum of a shot size and an injection cushion sufficient to compensate, during injection, for

potential back-flow across the non-return valve from the chamber.

7. (Original) The reciprocating screw injection unit according to claim 6, wherein the rotational speed of the screw, in use, is constant.

8. (Original) The reciprocating screw injection unit according to claim 1, wherein, in use, the rotational speed of the screw is at a first speed during a recovery phase for the screw and, temporarily, variable towards a second speed for at least a portion of an injection phase, the second speed being lower than the first speed.

9-12. (Cancelled).

13. (Presently amended) A controller of an injection molding machine, the controller arranged, in use, to control axial positioning of a reciprocating and continuously rotating feedscrew through selective control of back-pressure, the controller further arranged to support and control the development, in use within the injection molding machine, of back-pressure for material injection directly into one of a mold and a runner system;

wherein the controller is arranged to maintain, in use, a substantially zero recovery rate for the screw during an injection phase, the recovery rate relating to rotational speed of the screw and back-pressure developed, in use, within an injection unit of the injection molding machine; and

~~The controller according to claim 12,~~ wherein the controller, in use, causes selective variation of at least one of:

a) the back-pressure; and

b) the rotational speed of the screw;

thereby to control axial translation of the screw and selectively and dynamically to vary, in use, the recovery rate during an operational cycle of the injection unit.

14. (Presently amended) A controller of an injection molding machine, the controller arranged, in use, to control axial positioning of a reciprocating and continuously rotating feedscrew through selective control of back-pressure, the controller further arranged to support and control the development, in use within the injection molding machine, of back-pressure for material injection directly into one of a mold and a runner system;

wherein the controller is arranged to maintain, in use, a substantially zero recovery rate for the screw during an injection phase, the recovery rate relating to rotational speed of the screw and back-pressure developed, in use, within an injection unit of the injection molding machine; ~~The controller according to claim 13,~~ wherein the controller is configured, in use, to decrease temporarily the rotational speed of the screw during an injection phase of the operation cycle relative to a rotational speed of the screw during a recovery phase of the operational cycle; and

wherein the controller, in use, causes selective variation of at least one of:

a) the back-pressure; and

b) the rotational speed of the screw;

thereby to control axial translation of the screw and selectively and dynamically to vary, in use, the recovery rate during an operational cycle of the injection unit.

15. (Presently amended) A controller of an injection molding machine, the controller arranged, in use, to control axial positioning of a reciprocating and continuously

rotating feedscrew through selective control of back-pressure, the controller further arranged to support and control the development, in use within the injection molding machine, of back-pressure for material injection directly into one of a mold and a runner system;

wherein the controller is arranged to maintain, in use, a substantially zero recovery rate for the screw during an injection phase, the recovery rate relating to rotational speed of the screw and back-pressure developed, in use, within an injection unit of the injection molding machine;

wherein the controller is configured, in use, to decrease temporarily the rotational speed of the screw during an injection phase of the operation cycle relative to a rotational speed of the screw during a recovery phase of the operational cycle; ~~The controller according to claim 14,~~

wherein the controller is responsive, in use, to sensed pressure, location and speed signals associated with an injection unit and the controller, in use, acts substantially to maintain a zero recovery rate during an injection phase of the operation cycle; and

wherein the controller, in use, causes selective variation of at least one of:

a) the back-pressure; and

b) the rotational speed of the screw;

thereby to control axial translation of the screw and selectively and dynamically to vary, in use, the recovery rate during an operational cycle of the injection unit.

16. (Cancelled).

17. (Presently amended) A method of operating a reciprocating feed screw of an injection unit having a non-return valve associated therewith, the non-return valve permitting the injection unit to operate at injection

pressures, the method comprising:

rotating the reciprocating screw at a speed above zero revolutions per minute over the entire injection molding cycle; and

~~The method of operating the reciprocating feed screw according to claim 16, further comprising:~~

in a chamber downstream of a non-return valve of the feed screw, accumulating melt until a desired volume is accumulated;

increasing back-pressure in the injection system both to establish a substantially zero recovery rate for the feed screw and to prohibit any further increase in the volume for melt accumulation.

18. (Presently amended) A method of operating a reciprocating feed screw of an injection unit having a non-return valve associated therewith, the non-return valve permitting the injection unit to operate at injection pressures, the method comprising:

rotating the reciprocating screw at a speed above zero revolutions per minute over the entire injection molding cycle; and

in a chamber downstream of a non-return valve of the feed screw, accumulating melt until a desired volume is accumulated;

increasing back-pressure in the injection system both to establish a substantially zero recovery rate for the feed screw and to prohibit any further increase in the volume for melt accumulation; and

~~The method of operating the reciprocating feed screw according to claim 17, the method comprising:~~

further increasing back-pressure within the system to produce injection of the melt from the chamber into a mold.

19. (Presently amended) A method of operating a reciprocating feed screw of an injection unit having a non-return valve associated therewith, the non-return valve permitting the injection unit to operate at injection pressures, the method comprising:

rotating the reciprocating screw at a speed above zero revolutions per minute over the entire injection molding cycle; and

in a chamber downstream of a non-return valve of the feed screw, accumulating melt until a desired volume is accumulated;

increasing back-pressure in the injection system both to establish a substantially zero recovery rate for the feed screw and to prohibit any further increase in the volume for melt accumulation;

further increasing back-pressure within the system to produce injection of the melt from the chamber into a mold; and

~~The method of operating the reciprocating feed screw according to claim 18, the method comprising:~~

sensing at least one of a pressure environment, screw location and rotational speed of the screw; and

controlling axial translation of the screw and selectively and dynamically varying the recovery rate of the injection unit during the injection cycle in response to corresponding ones of the pressure environment, screw location and rotational speed by adjusting at least one of:

a) the back-pressure; and

b) the rotational speed of the screw.

20. (Presently amended) A method of operating a reciprocating feed screw of an injection unit having a non-return valve associated therewith, the non-return valve permitting the injection unit to operate at injection

pressures, the method comprising:

rotating the reciprocating screw at a speed above zero revolutions per minute over the entire injection molding cycle;

in a chamber downstream of a non-return valve of the feed screw, accumulating melt until a desired volume is accumulated;

increasing back-pressure in the injection system both to establish a substantially zero recovery rate for the feed screw and to prohibit any further increase in the volume for melt accumulation; and

~~The method of operating the reciprocating feed screw according to claim 17, the method comprising:~~

accumulating melt in the chamber until the volume of accumulated melt is equal to a sum of a shot size required for molding a part and an injection cushion volume sufficient to compensate, during injection, for potential back-flow across a non-return valve upstream of the chamber.

21-32. (Cancelled).

33. (Previously presented) An injection molding machine including having an injection unit base comprising:

a barrel with an axially translating and reciprocating screw therein, the barrel having a nozzle to support, in use, injection of melt into one of a runner system and a mold, the screw having associated therewith a non-return valve downstream of which a volume of melt can, in use, be accumulated;

a first actuator arranged to effect axial movement of the screw relative to the barrel and to generate, in use, back-pressure;

a second actuator coupled to the screw to control, in use, rotational speed of the screw; and

a controller for controlling operation of the screw and the first actuator, the controller arranged to set an axial position for the screw that defines the volume of melt to be accumulated downstream of the non-return valve by effecting, in use, an increase in the back-pressure to prohibit any further increase in the volume for melt accumulation and to render a recovery rate for the screw as being substantially zero and wherein the controller is arranged to ensure that, during use, the screw rotates continuously.

34. (Original) The injection molding machine according to claim 33, wherein the controller causes, during each injection cycle, selective variation of at least one of:

a) the back-pressure; and

b) the rotational speed of the screw;

thereby to control axial translation of the screw and selectively and dynamically to vary the recovery rate of the injection unit during the injection cycle.

35. (Original) The injection molding machine according to claim 34, further including a pressure transducer coupled to the controller.

36. (Original) The injection molding machine according to claim 34, further including a screw position transducer coupled to the controller and responsive to the screw, the screw position transducer relaying screw position information to the controller for the purposes of at least one of:

back-pressure control; and

recovery rate control.

37. (Original) The injection molding machine

according to claim 36, further including a screw speed sensor coupled to the controller and the second actuator, the screw speed sensor relaying screw speed information to the controller for the purposes of dynamic recovery rate control during each injection cycle.

38. (Original) The injection molding machine according to claim 33, wherein the screw has a tip located downstream of and proximate to the non-return valve and the barrel further has a chamber in front of the tip and into which chamber melt accumulates, the chamber having a final volume defined as a sum of a shot size and an injection cushion sufficient to compensate, during injection, for potential back-flow across the non-return valve from the chamber.

39. (Original) The injection molding machine according to claim 38, wherein the rotational speed of the screw, in use, is constant.

40. (Original) The injection molding machine according to claim 35, wherein, in use, the rotational speed of the screw is at a first speed during a recovery phase for the screw and, temporarily, variable towards a second speed for at least a portion of an injection phase, the second speed being lower than the first speed.